Recent investigations have clearly shown that atmospheric nitrogen plays an important part in the nutrition of plants. The assimilation of nitrogen from the atmosphere can only result from the activity of a microbe which is present in the soil. Fertility of the soil is, in case of certain plants, largely dependent upon the existence of this bacterium. It is probable that a study of the part played by the bacteria in the soil will prove of great importance. The results already obtained in introducing bacteria into the soil have been most encouraging in the case of certain plants.

The paper was discussed by Profs. G. E. Patrick, J. L. Howe and W. O. Atwater. Prof. Atwater described the experiments which are being conducted in this country and abroad to determine comparative values of foods and the quantities of food required by people of different classes and occupations.

A paper by Prof. Milton Whitney, on 'Recent Progress in the Analysis of Soils,' was omitted owing to the absence of the author. Mr. J. T. Morehead read a paper on 'Calcium Carbide.' The author described the process of manufacture in an electric furnace. The furnace is constructed of ordinary brick and is covered. Vertically supported carbon rods, 4 inches thick, constitute the positive electrode. A plate of iron at the bottom of the furnace, covered by a layer of carbon, forms the negative electrode. The charge consists of a mixture of ground lime and coke.

A current of 100 volts and 1700 amperes produces 80 pounds per hour of calcium carbide. The product is a hard crystalline substance having the composition $Ca\ C_2$. Immersed in water it is decomposed with violence but with very little heat, and yielding slacked lime almost white in color. Five cubic feet of acetylene gas are produced by one pound of carbide. Large quantities of the carbide are now being manufactured by the Wilson Aluminum Company in their works situated at Spray, N. C. After a tribute of thanks to Dr. Wm. McMurtrie, Vice-President of the Section of Chemistry, the Section adjourned.

SECTION D. MECHANICAL SCIENCE AND ENGINEERING.

The chairman of Section D, William Kent, of Passaic, N. J., and the secretary, Professor Henry S. Jacoby, of Ithaca, N. Y., were both present throughout the meeting of the Association. The Vice-President's address, which is published on page 321 of Science, was delivered on Thursday afternoon, August 29th, and excited more than usual interest outside as well as in the Section by its able exposition of the work of the engineer as related to economic progress.

The papers were read on Friday. That of H. N. Ogden, of Ithaca, N. Y., treated of the 'Economics of Engineering Public Works.' After an introduction referring to the extravagance of the American people, and to the influences which favored individual action and rendered unnecessary the combination of interests by coöperation until recently, instances were given of corporations seeking advantage at the expense of the public good. The tearing-up of city streets, and digging one trench for gas pipes, another for water pipes, and others for sewers and steam pipes, without any mutual arrangement, was given as an illustration of the most common lack of economy in municipal affairs, as the people ultimately pay for all the trenches and suffer the loss incident to breaking up the streets so frequently, interfering with traffic and often ruining the paving. Similar extravagance is seen in the conduct of elections and the assessment and collection of taxes. Numerous instances of the ability of our people to adapt means to ends, to devise new methods to changed conditions, give hope

for the future. The Interstate Commerce Law, railroad commissions, the appreciation of the value of city franchises and the utilization of garbage wastes are evidences of progress in public economy. The importance of deciding by a competent authority the relation of our streams to pure water supply and to carrying off sewage was urged as one of many problems demanding more careful attention.

In the discussion which followed, E. L. Corthell, in alluding to the author's statements concerning competition, considered it unwise for any government to decide what division shall be made between transportation by rail and by water. In France it was found necessary to keep up the rates on the railroads in order to save the existence of the canals. Multiplying the means of transportation tends to lower the rates. The Interstate Commerce Commission can prevent the throwing away of money in the unnecessary construction of new railroads.

Professor O. H. Landreth spoke of the immense investment made for the water supply of Boston and of 25 or 30 towns by coöperation, and Vice-President Kent called attention to the corner in the water supply in northern New Jersey secured by large corporations.

In a paper on the 'Mathematical Theory of the Windmill,' by Professor DeVolson Wood, of Stevens Institute of Technology, a formula was derived for the pneumatic energy of the wind upon a sail, and the results were compared with those given in Wolff's Treatise on Windmills.

Professor Mansfield Merriman, of Lehigh University, presented a valuable paper on 'Partially Continuous Drawbridge Trusses, with a Method of Deducing Formulas for the Reactions.' The first case of partial continuity considered was the rim-bearing drawbridge without webbing in the panel over the support. The second was that of the double rolling draw, where the webbing is continuous but not the chords, and the third case was that of the double swing-bridge, which is a combination of the first two. In all these cases the value of the reactions deduced were found to be intermediate between those for simple and for continuous trusses.

A paper by Professor J. J. Flather, of Purdue University, gave the results of some 'Experiments on the Flow of Steam and a Comparison with those obtained by Napier's Formula.' The difference was very small and some of the conditions under which the experiments were made were such as to require additional experiments to be made.

Professor H. S. Jacoby, of Cornell University, read a paper on the 'Design of Fish-Plate Timber Joints,' in which formulas were given for the resultant pressure of the side of round bolts or pins against the timber both in the direction of the fiber and perpendicular to that. For yellow pine with compressive stresses of 1100 and 300 pounds per square inch on the ends and on the sides of the fiber respectively, the former resultant was 0.627 times the product of the diametral projection of the surface of the bolt by the compressive stress on the ends of the fibers, while that of the latter was 0.4 times the same product. The force tending to split the timber when the resultant pressure is in the direction of the fibers is one-half of this last amount. The corresponding value of the resultant in the direction of the fibers obtained by experiment was found to have an average constant of 0.60 instead of the theoretic value of 0.627. The radial angle with the fibers at which the fibers begin to crush sidewise was also determined theoretically and by experiment and the agreement was very close. For the above timber the angle was 15° 37′ to 17° 00′ in the experiments, the theoretic value being 15° 50′. The tendency to split the timber must be provided for either by transverse bolts or by

increasing the longitudinal shearing surface which would otherwise be required.

The officers of the Section elected for the next year by the Association are Professor F. O. Marvin, of the University of Kansas, for Chairman, and Professor J. Galbraith, of the School of Practical Science, of Toronto, Canada, for Secretary.

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*DEVELOPMENT OF VEGETABLE PHYSIOLOGY.**

THERE is a certain fitness in bringing before the section of this Association, which has been most recently established, some account of that department of botanical science which is one of the latest to be brought into notice as a grand division of the subject. For vegetable physiology, the topic which is to engage our attention, is like a western or African domain, long inhabited at the more accessible points, more or less explored over the larger portion, but with undefined boundaries in some directions, and with rich and important regions for some time known to the explorer, but only now coming to the attention of the general public. In fact, our domain of vegetable physiology is found to be a diversified one, in some parts by the application of chemical and physical methods yielding rich gold and gems, in other parts coming nearer to every man's daily interests with its fruits and grains. Thus it comes about that, before the public is well acquainted with the name of the science, it has differentiated itself into two or three sciences having quite separate objects in view.

It is the purpose of this address to acquaint you with the growth and present outlines of the group of sciences which for convenience are included under the heading of vegetable physiology, and also to show why they deserve recognition as important constituents of a liberal education along with other natural sciences. The point of view at all times will be that of the American botanist.

In the development of botany in America the science has passed through successive waves or stages of popularity, constantly increasing in momentum, widening its scope by evolution of new interests, and more and more exhibiting virility by its adaptability to the needs of the times. That botany has in it something that may be transmuted into money has only recently been discovered, but it is a discovery that is likely to work benefit not only to the practical man who makes application of scientific truths to commercial ends, but also reciprocally to the investigator who thinks only of uncovering a new fact or establishing a new law. To adequately meet the requirements of modern botany in the way of laboratories, gardens, herbaria, libraries and apparatus requires a capital that not long since would have been deemed fabulous. The money to meet this demand of a growing science must be expected to come in the main as the voluntary contribution of an interested public—the reciprocal response to the attitude of botany toward the general welfare.

I have mentioned the economic aspect of botany thus early, because it is one of the significant changes which has come over the science within the last decade or two, and to which vegetable physiology in some of its features is, I venture to say, about to add further important contributions. Science no longer shrinks into the shadow of the closet for fear of being implored to lend a hand at securing revenue, but steps forth and curiously scrutinizes every process of the practical world, often finding there its most fruitful fields for fundamental research.

The problems of vegetable physiology possess to a greater or less degree a special

*Address of the Vice-President, Section G., American Association for the Advancement of Science at the Springfield Meeting, August 29, 1895.